Computer Organization and Design (4th)
by Hennessy, Patterson
Chapter 6.15, Problem 1E

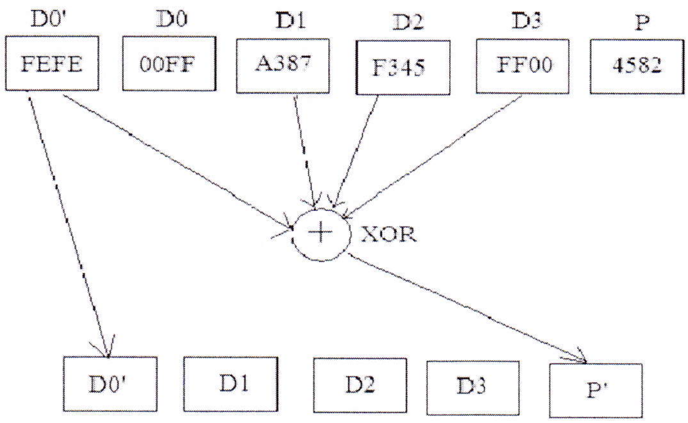
Step 1

a) Given data:

D0' = FEFE, D0 = 00FF
D1 = A387, D2 = F345
D3 = FF00, P = 4582
P' = ?

Step 2

The following figure describes how to find new parity P' for RAID 3.



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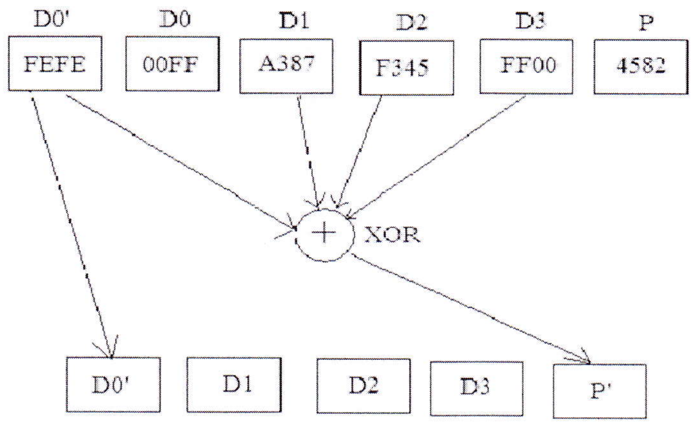


Step 3

Then perform XOR operation with data D0', D1, D2, D3 then get new parity P'

The data values in hexadecimal form before perform the XOR operation, the data values can be converted in to equivalent binary form. Then the values are:

D0' = $(FEFE)_{16}$ = $(1111\ 1110\ 1111\ 1110)_2$

D1 = $(A387)_{16}$ = $(1010\ 0011\ 1000\ 0111)_2$

D2 = $(F345)_{16}$ = $(1111\ 0011\ 0100\ 0101)_2$

D3 = $(FF00)_{16}$ = $(1111\ 1111\ 0000\ 0000)_2$

Step 4

XOR Operation:

First perform XOR operation with D0' and D1 then get X value.

D0' = 1111 1110 1111 1110

D1 = 1010 0011 1000 0111

X = 0101 1101 0111 1001

Second perform XOR operation with D2 and D3 then get Y value.

D2 = 1111 0011 0100 0101

D3 = 1111 1111 0000 0000

Y = 0000 1100 0100 0101

Step 5

Finally perform XOR operation with X and Y values then get new parity P'

X = 0101 1101 0111 1001

Y = 0000 1100 0100 0101

P' = 0101 0001 0011 1100

Therefore P'= $(0101\ 0001\ 0011\ 1100)_2$

$= (\ 5\quad 1\quad 3\quad C\ )_{16}$

$\boxed{P' = (513C)_{16}}$

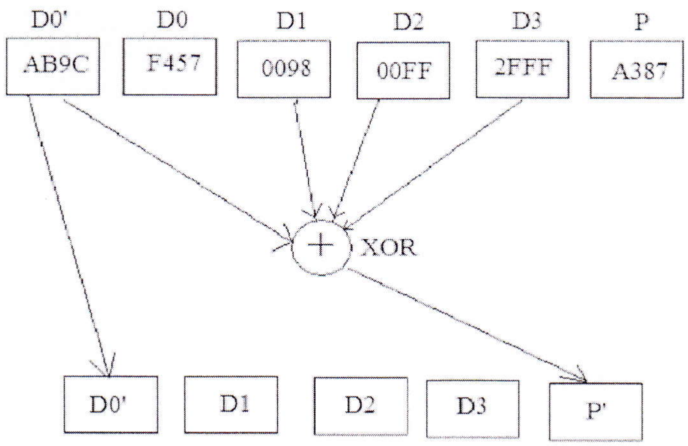
Step 6

b) Given data:

D0' = AB9C, D0 = F457
D1 = 0098, D2 = 00FF
D3 = 2FFF, P = A387
P' = ?

Step 7

The following figure describes how to find new parity P' for RAID 3.



Step 8

Then perform XOR operation with data D0', D1, D2, D3 then get new parity P'

The data values in hexadecimal form, so before the perform XOR operation the data values can be converted in to equivalent binary form. Then the values are:

D0' = $(AB9C)_{16}$ = $(1010\ 1011\ 1001\ 1100)_2$

D1 = $(0098)_{16}$ = $(0000\ 0000\ 1001\ 1000)_2$

D2 = $(00FF)_{16}$ = $(0000\ 0000\ 1111\ 1111)_2$

D3 = $(2FFF)_{16}$ = $(0010\ 1111\ 1111\ 1111)_2$

Step 9

XOR Operation:

First perform XOR operation with D0' and D1 then get X value.

D0' = 1010 1011 1001 1100

D1 = 0000 0000 1001 1000

X= 1010 1011 0000 0100

Second perform XOR operation with D2 and D3 then get Y value.

D2 = 0000 0000 1111 1111

D3 = 0010 1111 1111 1111

Y = 0010 1111 0000 0000

Step 10

Finally perform XOR operation with X and Y values then get new parity P'

X = 1010 1011 0000 0100

Y = 0010 1111 0000 0000

P' = 1000 0100 0000 0100

Therefore P'= $(1000\ 0100\ 0000\ 0100)_2$

$= (8 \quad 4 \quad 0 \quad 4)_{16}$

$\boxed{P' = (8404)_{16}}$

Computer Organization and Design (4th)
by Hennessy, Patterson
Chapter 6.15, Problem 2E

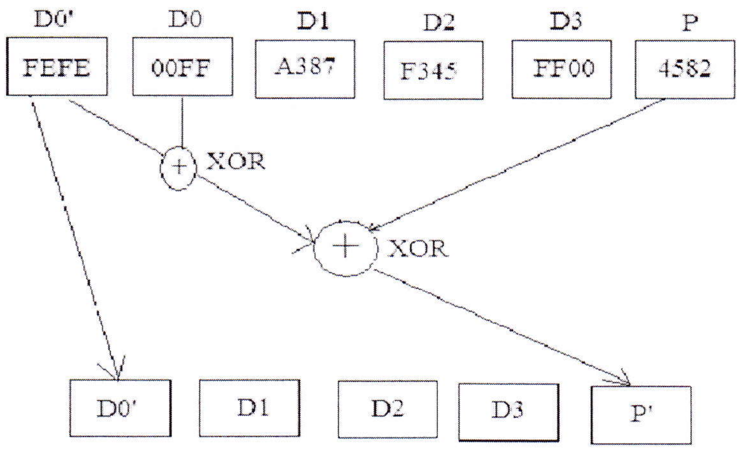
Step 1

a) Given data:

D0' = FEFE, D0 = 00FF
D1 = A387, D2 = F345
D3 = FF00, P = 4582
P' = ?

Step 2

The following figure describes how to find new parity P' for RAID 4.



Step 3

Then perform XOR operation with data D0', D0 and P then get new parity P'.

The data values in hexadecimal form, so before the perform XOR operation the data values can be converted in to equivalent binary form. Then the values are:

$D0' = (FEFE)_{16} = (1111\ 1110\ 1111\ 1110)_2$

$D0 = (00FF)_{16} = (0000\ 0000\ 1111\ 1111)_2$

$D1 = (A387)_{16} = (1010\ 0011\ 1000\ 0111)_2$

$D2 = (F345)_{16} = (1111\ 0011\ 0100\ 0101)_2$

$D3 = (FF00)_{16} = (1111\ 1111\ 0000\ 0000)_2$

$P = (4582)_{16} = (0100\ 0101\ 1000\ 0010)_2$

Step 4

XOR Operation:

First perform XOR operation with D0' and D0 then get X value.

D0' = 1111 1110 1111 1110

D0 = 0000 0000 1111 1111

X = 1111 1110 0000 0001

Then perform XOR operation with P and X then get new parity P'.

P = 0100 0101 1000 0010

X = 1111 1110 0000 0001

P' = 1011 1011 1000 0011

Step 5

Therefore $P' = (1011\ 1011\ 1000\ 0011)_2$

$= (\ B\quad B\quad 8\quad 3\ )_{16}$

$\boxed{P' = (BB83)_{16}}$

Step 6

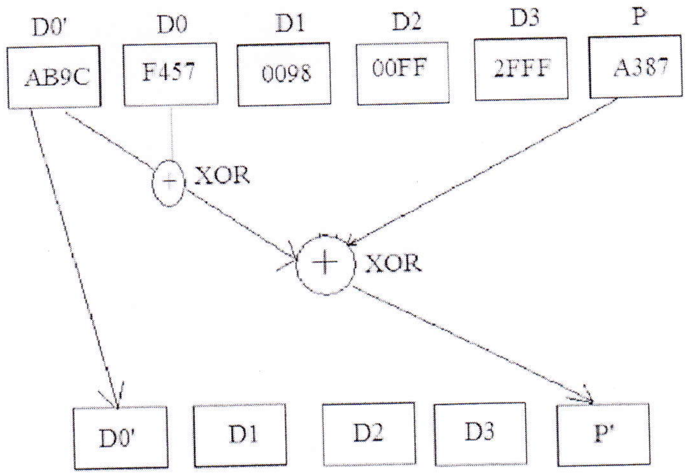
b) Given data:

D0' = AB9C, D0 = F457
D1 = 0098, D2 = 00FF
D3 = 2FFF, P = A387
P' = ?

Computer Organization and Design (4th)
by Hennessy, Patterson
Chapter 6.15, Problem 2E

Step 7

The following figure describes how to find new parity P' for RAID 3.



Computer Organization and Design (4th)
by Hennessy, Patterson
Chapter 6.15, Problem 2E

Step 8

Then perform XOR operation with data D0', D0 and P then get new parity P'

The data values in hexadecimal form, so before the perform XOR operation the data values can be converted in to equivalent binary form. Then the values are:

$D0' = (AB9C)_{16} = (1010\ 1011\ 1001\ 1100)_2$

$D0 = (F457)_{16} = (1111\ 0100\ 0101\ 0111)_2$

$D1 = (0098)_{16} = (0000\ 0000\ 1001\ 1000)_2$

$D2 = (00FF)_{16} = (0000\ 0000\ 1111\ 1111)_2$

$D3 = (2FFF)_{16} = (0010\ 1111\ 1111\ 1111)_2$

$P = (A387)_{16} = (1010\ 0011\ 1000\ 0111)_2$

Step 9

XOR Operation:

First perform XOR operation with D0' and D0 then get X value.

D0' = 1010 1011 1001 1100

D0 = 1111 0100 0101 0111

X = 0101 1111 1100 1011

Then perform XOR operation with X and P then get new parity P'.

X = 0101 1111 1100 1011

P = 1010 0011 1000 0111

P'= 1111 1100 0100 1100

Step 10

Therefore P'= $(1111\ 1100\ 0101\ 1100)_2$

= (F C 4 C) 16

$\boxed{P' = (FC4C)_{16}}$

Computer Organization and Design (4th)
by Hennessy, Patterson
Chapter 6.15, Problem 3E

Step 1

RAID 4 is more efficient because it requires fewer reads to generate the next parity word value. It uses the same ratio of data RAID 4 efficiently supports a mixture of large reads, large writes, and small reads plus it allows small writes. RAID 3 uses byte-level striping where as RAID 4 uses block level striping. RAID 4 is very fast reads and high efficiency because low ratio of parity or data.

Computer Organization and Design (4th)
by Hennessy, Patterson
Chapter 6.15, Problem 4E

Step 1

RAID 5 is different from RAID 4 because RAID 5 writes the parity across all the disks. Data redundancy is provided by the parity information. Both data and parity information are arranged on the disk array. So, that the two types of information are always on different disks.

Step 2

The RAID 5 works well in the following situations:

1. In large databases, the numbers of reads occur than writes. Performance degrades as the percentage of write operations increases. And
2. Where a high degree of fault tolerance is required without the expense of a mirrored volume. A RAID-5 volume is significantly more efficient than a mirrored volume when larger numbers of disks are used.

Computer Organization and Design (4th)
by Hennessy, Patterson
Chapter 6.15, Problem 5E

Step 1

As the number of disks grows by 1, the number of accesses required to calculate a parity word in RAID 3 also grows by 1. In contrast, RAID 4 and 5 continue to access only existing values of data being stored. Thus, as the number of disks grows, RAID 3 performance will continue to degrade while RAID 4 and 5 will remain constant.

Step 2

Regarding performance issue, there is no performance benefit for RAID 4 or 5 over RAID 3 for small numbers of disks. For 2 disks, there is no difference.